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**A Comparison of Atlantic Salmon
Returns to the Lower and Middle
Exploits River.**

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**Comparaison des remontes de
saumon atlantique dans les cours
inférieur et moyen de la rivière
Exploits.**

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Abstract

The status of Atlantic salmon in the lower and middle Exploits was examined for the period 1993 to 2002. Analysis revealed that while the size of the stock in the middle Exploits is maintaining itself or increasing slightly, the stock in the lower Exploits is declining. While the reasons for this decline cannot be documented, it is not believed to be related to degradation of habitat. The most notable change within the lower watershed is an increase in accessibility through cabin/road development. Since the moratorium on commercial salmon fishing in 1992, the only legal removals of salmon is in the recreational fishery. Concern is expressed with illegal removals of salmon within the lower Exploits watershed. Further management action is required to ensure that the lower Exploits watershed achieves conservation egg deposition.

Résumé

L'état des stocks de saumon atlantique dans les cours inférieur et moyen de la rivière Exploits de 1993 à 2002 a été examiné. L'analyse a révélé que la taille du stock du cours moyen est stable ou augmente légèrement, mais que celle du stock du cours inférieur est en baisse. Les raisons de cette baisse ne peuvent être documentées, mais celle-ci ne semble pas être liée à une dégradation de l'habitat. Le changement le plus important survenu dans la partie inférieure du bassin versant de la rivière Exploits a été une augmentation de l'accessibilité par le biais de l'aménagement de routes et de cabines. Depuis l'adoption du moratoire sur la pêche commerciale du saumon en 1992, seules les prises récréatives de saumon sont permises. Les prises illégales de saumon dans la partie inférieure du bassin versant soulèvent des préoccupations. Davantage de mesures de gestion doivent être prises pour que les objectifs de conservation en matière de ponte soient respectés dans cette partie du bassin de la rivière Exploits.

Introduction

The Exploits River watershed was the site of a major Atlantic salmon enhancement/colonization program from 1957 to 1993 (Bourgeois et.al 2001). Figures 1 and 2 detail the Salmon Fishing Areas (SFA) for insular Newfoundland and a detailed map of the Exploits watershed, respectively. Historically less than 10% of the habitat within the watershed was accessible to anadromous Atlantic salmon. Through fishway construction coupled with various stocking options anadromous Atlantic salmon now have access to most of the watershed. Prior to enhancement, Atlantic salmon had access only to habitat in the tributaries downstream of Grand Falls (Fig. 2) which encompassed the historical salmon population. It is the intent of this manuscript to examine the changes in the population size of salmon in the lower and middle sections of the watershed since 1993.

Background

The development of the watershed from an enhancement perspective was completed in three phases associated with the three main sections of the watershed. The three watershed sections are as follows; lower Exploits – the area of the watershed downstream of the Grand Falls; middle Exploits – the area of the watershed upstream of Grand Falls to the outflow of Red Indian Lake; upper Exploits – the area of the watershed upstream of Red Indian Lake dam. Phase 1 (lower Exploits) was completed from 1957 to 1964 and encompassed the opening up of the habitat in Great Rattling Brook and the stocking of adult salmon in this habitat. Phase 2 was completed from 1968 to 1981 through fry stocking in the tributaries of the middle Exploits. The mainstem of this section of the watershed was stocked with fry from 1987 to 1993. Phase 3 (upper Exploits) utilized fry stocking as well and was completed from 1981 to 1991.

Methods

Pertinent information with respect to annual assessments of the stock status of the Exploits River watershed can be found in Bourgeois et.al (2001). At present stock status (% conservation egg deposition achieved) is derived for the entire watershed and for the lower, middle and upper sections of the watershed separately. Stock status for the watershed is determined from salmon counted at fishways, angling statistics and other known removals. All fish entering the watershed, less angling and other removals downstream of the fishway, are enumerated at the Bishops Falls fishway (Fig. 2). River escapement = count at Bishops Falls + angling removals below Bishops Falls + known removals. All fish entering the middle and upper Exploits watershed are enumerated at the Grand Falls fishway (Fig.2). All fish entering the upper watershed are enumerated at the fishway at the outflow of Red Indian Lake (Fig. 2).

Angling catch and effort data prior to 1994 were supplied by DFO River Guardians and from 1994 to 1996 the data were collected by DFO River Guardians and River Monitors. Beginning in 1997 angling statistics are those of the License Stub Return System. For detail on the apportioning of the Exploits angling catch see (Bourgeois et. al. 2001).

Data analysis included examination of river escapement, counts at fishway and know number of spawners for the lower and middle sections of the watershed. The trends in the number of spawners for the lower and middle Exploits were plotted and the slope of the relationships were examined.

Results

Counts of Atlantic salmon at Bishops Falls, Grand Falls and Red Indian Lake Fishway are provided in Table 1. Table 2 details the angling statistics for the Exploits watershed. Table 3 provides the percent conservation egg deposition achieved for the lower and middle sections of the watershed since 1993.

Figure 3 is a plot of the river escapement on year for the Exploits watershed from 1975 to present. The overall trend in the population size is increasing and this is confirmed with the positive slope of the regression line ($y=582.85x-1E+06$) although the relationship is not significant. Figure 4 shows the count of salmon at Bishop Falls fishway since 1975 with pre moratorium and moratorium means respectively. The mean count of salmon at the Bishops Falls fishway has doubled since 1992 and is a general indicator of the direct impact of the moratorium on the Exploits River salmon stock. Figure 5 details the river escapement of salmon in the Exploits watershed for the 1993 to 2002 time period (post enhancement time frame). The negative slope of the regression line reveals that the overall population is in decline although this relationship is not significant ($y=-250.27x+ 520875$). Figure 6 shows the count of salmon at the Grand Falls fishway (1975 to present) and the percent of the count at Bishop Falls count enumerated at Grand Falls Fishway. Since 1996 the proportion of the fish enumerated at Bishop Falls fishway that are also enumerated at the Grand Falls fishway has been on average over 45% and been relatively stable as compared to previous years. The trend is increasing suggesting that the stock in the middle Exploits is on the increase as compared to the lower Exploits. Figure 7 plots the number of spawners (spawning escapement) (1993 to present) by year for the lower and middle Exploits sections of the watershed. The slopes of the regression lines indicate that the number of spawners is declining for the lower section of the watershed while the number of spawners is increasing slightly for the middle section of the watershed (lower $y=-630.39x+1E+06$; middle $y=379.13x-748916$). Angling removals within the lower section of the watershed greatly reduce the spawner escapement to the lower Exploits and regulation of the recreational fishery is the only management option to control egg deposition within this section of the watershed. Over ninety percent of all angling occurs within the lower Exploits. Spawners are watershed escapement

less angling and other know removals. Illegal removals would reduce the number of spawners presented in Figure 7.

Discussion

The Exploits River Atlantic salmon population has continued to develop and grow since early enhancement initiatives in the late 1950's and in particular since 1975 (Figure 3). Enhancement activities ceased in 1993 with the fry stocking conducted in that year and the last adult returns from enhancement activities were realized in 1998. The moratorium on the commercial fishing of Atlantic salmon in 1992 as well as enhancement activities contributed to the increased escapement to the watershed (Figure 4) basically doubling the river escapement of salmon. Recreational fishery statistics reveal an increase in harvest since the moratorium and documents that over 90% of the salmon angled came from the lower Exploits. A goal of the moratorium on the commercial fishing of Atlantic salmon was that the salmon allowed to escape to the rivers would not be reallocated to the recreational fishery. Table 2 reveals the opposite to be true in that the recreational catch greatly increased during the moratorium.

The major focus of this study is a comparison of the spawners/returns for the lower and middle Exploits since 1993. This year was chosen so as to remove the influence of fry stocking in the egg deposition calculations, since prior to this, fry in year x were backcalculated to eggs in year x-1 (see Bourgeois et. al. 2001 for details). Additionally since the moratorium in 1992, river escapement is assumed to be equivalent to total salmon production.

The mean percent conservation egg deposition achieved for the lower Exploits is 117% (60%-210%) whilst the middle Exploits has a mean percent conservation egg deposition of 26% (15%-43%). The area of the watershed known as the lower Exploits underwent enhancement activities in the late 1950's through the early 1960's and in recent years had been achieving conservation egg deposition. Since 1993 there has been greater variation in the percent conservation egg deposition achieved in the lower Exploits than in the middle Exploits suggesting the middle Exploits is more stable in terms of returns. The middle Exploits is well below it's required egg deposition indicating room for stock growth. The lower Exploits population has achieved conservation egg deposition in six of the last ten years; four out of five years from 1993 to 1997 and two out of five years from 1998 to 2002.

River escapement for the entire Exploits River from 1993 to present revealed a slight negative trend. It is obvious from Figure 6 that since 1996, a higher percentage of the total fish entering the Exploits are enumerated at the Grand Falls fishway. Table 3 reveals little or no change in the percent conservation egg deposition for this area of the watershed suggesting that this observation is not due to an increase in the number of spawners in the middle Exploits giving rise to

returns since 1996, but rather a decline in the number of spawners in the lower Exploits.

The trend in spawners for the lower Exploits was negative whilst for the middle it was positive. Table 3 suggests that in the most recent years the middle Exploits stock of the watershed is producing at the long term mean.

The data presented here suggest that the stock of Atlantic salmon within the lower Exploits is in decline whilst the stock within the middle Exploits is maintaining itself or growing somewhat slightly. This indicates that production, in terms of adults produced, within the lower Exploits has changed. This is somewhat difficult to understand in that the smolt produced from the middle section of the watershed have to circumvent two hydro generating stations while those in the lower watershed only have to circumvent a single hydro generating station. All studies to date have documented certain levels of turbine mortality and in the case of smolts out migrating the middle Exploits they encounter additional turbine mortality than the smolts from the lower Exploits. Within the lower Exploits smolt production occurs within the various tributaries whereas in the middle Exploits some smolt production maybe derived from the mainstem of the river. It is unlikely that there are extreme environmental variables associated with one part of the watershed and not the other or that smolts from the lower watershed have a lower sea survival than smolts from the middle section of the watershed.

In addition to possible differential mortality on smolts, smolt production in this lower section in recent years could be related to low egg deposition. Possible causes of low egg deposition are ;

- Low summer flows in tributaries may be affecting freshwater survival of parr.
- Low summer flows may be impacting adult survival.
- Increased cabin development/access to areas of Lower Exploits is causing habitat damage.
- Angling pressure (over 90% of which occurs in the lower Exploits) is targeting fish from the lower Exploits.
- The problem is one of illegal removals.

Management Considerations

A management strategy needs to be developed and implemented that will allow the lower Exploits watershed to achieve it's conservation egg deposition requirement.

References

- Bourgeois, C. E., J. Murray and V. Mercer. 2001. Status of the Exploits River stock of Atlantic salmon (*Salmo salar* L.) in 2000. DFO, CSAS Res. Doc. 2001/026.

Table 1. Counts at various counting facilities on the Exploits River.

Year	Count at Bishop Falls			Count at Grand Falls			Count at Red Indian Lake		
	Small	Large	total	Small	Large	total	small	large	total
1959	886	119	*1005						
1960	1013	157	1170						
1961	839	118	957						
1962		No data							
1963	1202	65	1267						
1964		No data							
1965	1228	203	1431						
1966	829	506	*1335						
1967	1372	710	2082						
1968		No data							
1969	979	498	1477						
1970		No data							
1971	961	300	1261						
1972	794	113	907						
1973	205	89	294						
1974	2538	411	2949	64	0	*64			
1975	9218	1439	10657	319	21	340			
1976	3991	460	4451	128	5	133			
1977	6148	581	6729	244	9	253			
1978	3790	303	4093	132	6	138			
1979	6715	277	6992	501	8	509			
1980		No data		3062	23	3085			
1981	8114	1695	*9809	3809	227	4036			
1982	7605	181	7786	2321	67	2388			
1983		No data		2182	37	2219			
1984	17219	529	17748	4993	50	5043			
1985	16652	183	16835	4992	11	5003			
1986	9697	355	10052	2243	67	2310			

Table 1 (Cont'd.)

Year	Count at Bishop Falls			Count at Grand Falls			Count at Red Indian Lake		
	Small	Large	total	Small	Large	total	small	large	total
1987	9014	310	9324	2211	41	2252			
1988	8974	147	9121	2535	34	2569			
1989	7192	89	7281	2737	70	2807			
1990	6629	122	6751	2697	118	2815			
1991	5245	99	5344			1614	29	0	29
1992	12538	314	12852	2609	64	2673	138	3	141
1993	21319	627	21946	5658	101	5759	571	14	585
1994	16168	916	17084	6430	196	6626	611	25	636
1995	15714	941	16655	N/A	N/A	6523	774	44	818
1996	29761	2053	31814	13489	906	14395	776	20	796
1997	13547	881	14428	5762	534	6296	170	24	194
1998	26442	1958	28400	12065	1217	13282	421	33	454
1999	28252	2235	30487	13530	1143	14673	602	39	641
2000	11817	683	12500	5523	523	6046	191	9	200
2001	18978	1346	20324	9292	698	9990	396	14	410
2002	15417	889	16306	7880	596	8476	277	3	300

Table 2. Angling statistics for Exploits River.

Year	Retained catch			Total Retained Catch	Total Released Catch	Total Effort
	Lower Exploits	Middle Exploits	Upper Exploits			
1975	1,619			1,619		5,702
1976	1,934			1,934		5,775
1977	1,852			1,852		6,944
1978	1,840			1,480		5,031
1979	1,431			1,431		8,363
1980	1,790			1,790		7,427
1981	1,861			1,861		7,515
1982	1,733			1,733		9,630
1983	1,353			1,353		5,079
1984	2,424			2,424		9,459
1985	2,998			2,998		8,600
1986	2,057			2057		8,123
1987	1,935			1935		5,891
1988	1,731			1731		6,181
1989	577			577		3,813
1990	917			917		5,869
1991	1,045			1045		5,931
1992	1,408			1408	199	4,347
1993	1,655			1655	3,039	7,896
1994	2,962	110	0	3072	1,175	16,330
1995	1,334	2	0	1,336	1,603	10,089
1996	1,787	128	0	1,915	3,313	11,987
1997	2,891	105	0	2,996	2,169	No data
1998	1,846	173	0	2,019	3,168	No data
1999	2,712	273	0	2,985	2,364	No data
2000	1,317	67	0	1,384	2,673	
2001*	2,131	112	0	2,243	1,554	

Table 2 (Cont'd.)

Year	Retained catch			Total Retained Catch	Total Released Catch	Total Effort
	Lower Exploits	Middle Exploits	Upper Exploits			
2002*	2,320	180	0	2,500	1,800	

* preliminary data

Table 3. Percent conservation egg deposition achieved for lower and middle Exploits 1993 – present.

Year	% Conservation Egg Deposition Achieved	
	Lower	Middle
1993	157	23
1994	103	18
1995	121	24
1996	210	43
1997	72	15
1998	146	35
1999	134	35
2000	60	16
2001	98*	27
2002	65*	25
Mean	117	26

*Preliminary figures as final angling statistics are not available.

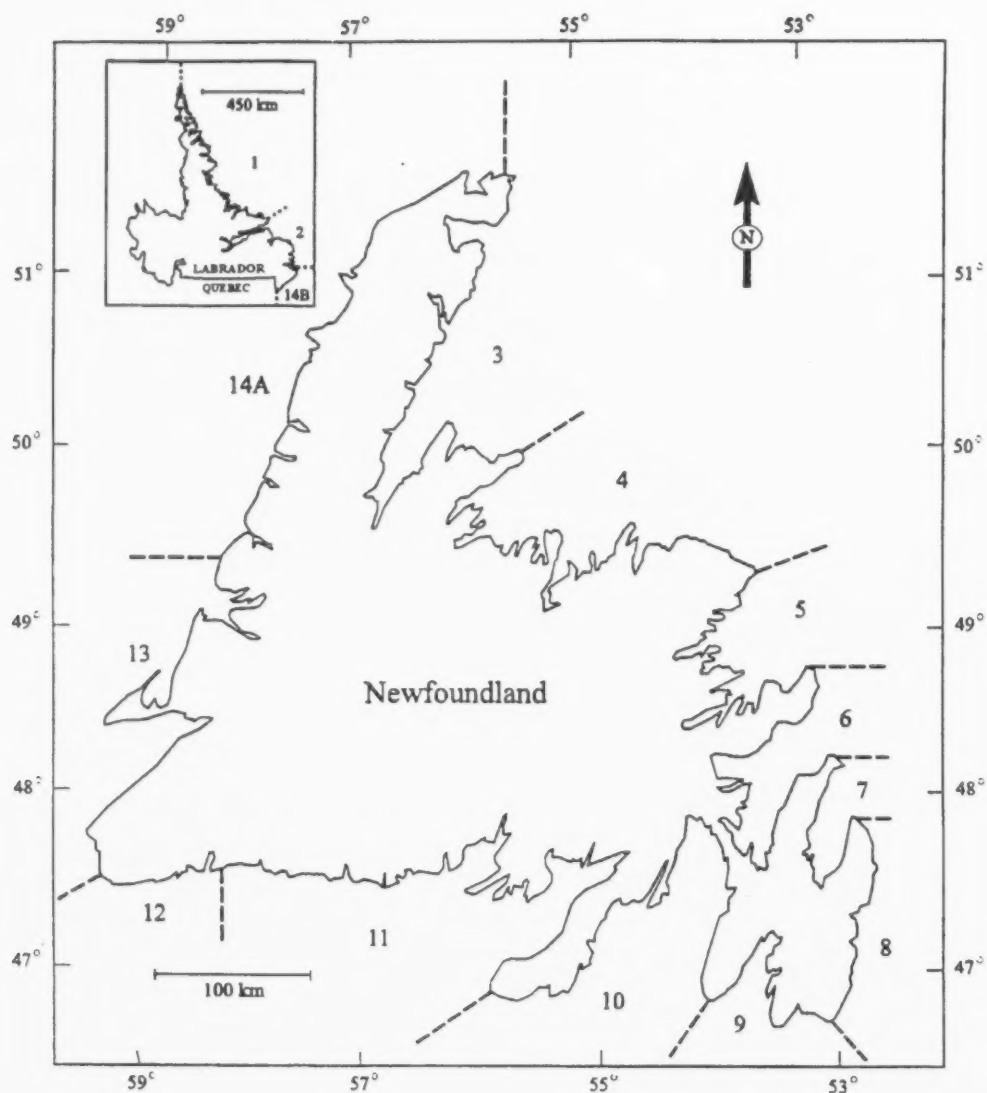


Fig. 1. Map showing the 14 Salmon Fishing Areas of the Newfoundland Region.

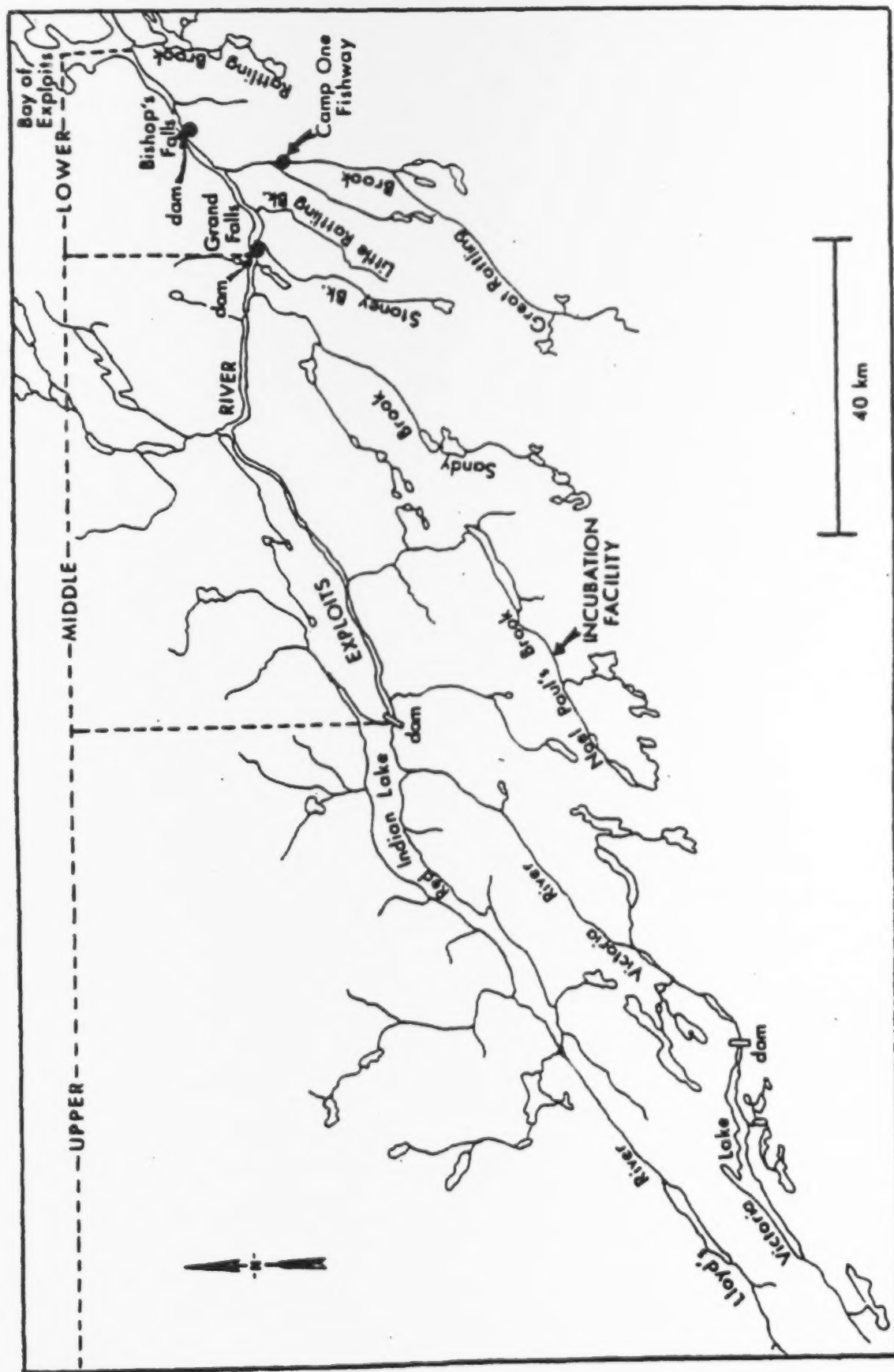


Fig. 2. Detailed map of the Exploits River system.

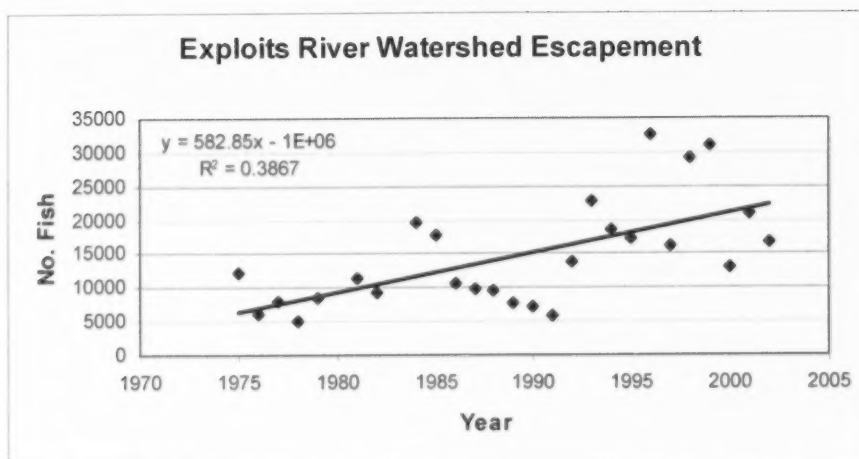


Figure 3: Plot of Exploits River Atlantic salmon escapement on year for the 1975 to 2002 period with trend line.

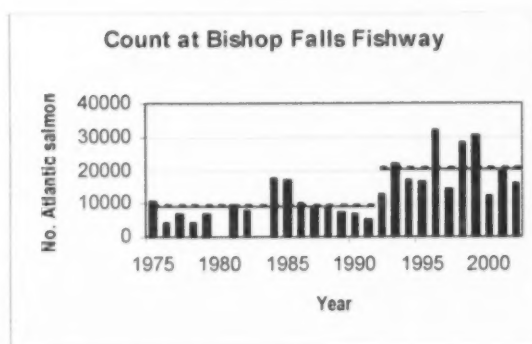


Figure 4: Graph of number of Atlantic salmon counted at Bishops Falls fishway 1975 to 2002 with pre and moratorium means.

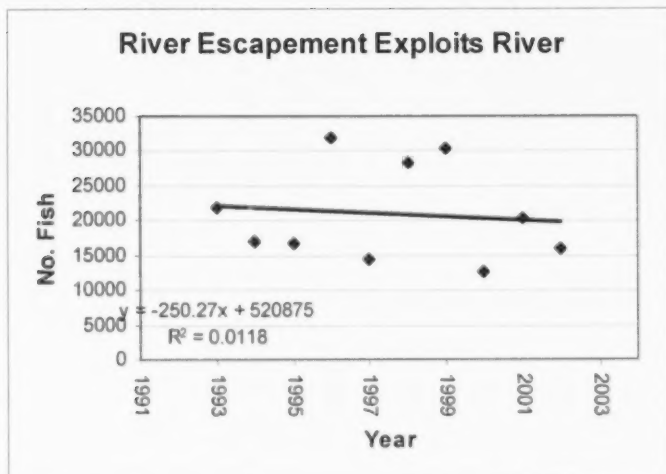


Figure 5: Plot of Exploits River escapement 1993 to 2002 with trend line.

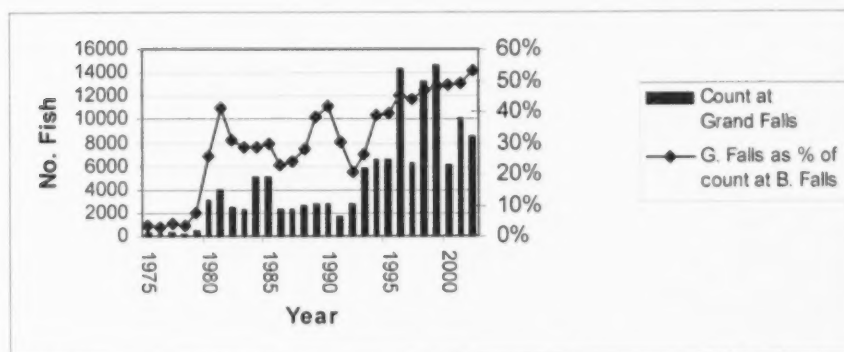


Figure 6: Count of fish at Grand Falls Fishway and % of run at Bishops Falls fishway enumerated at Grand Falls fishway.

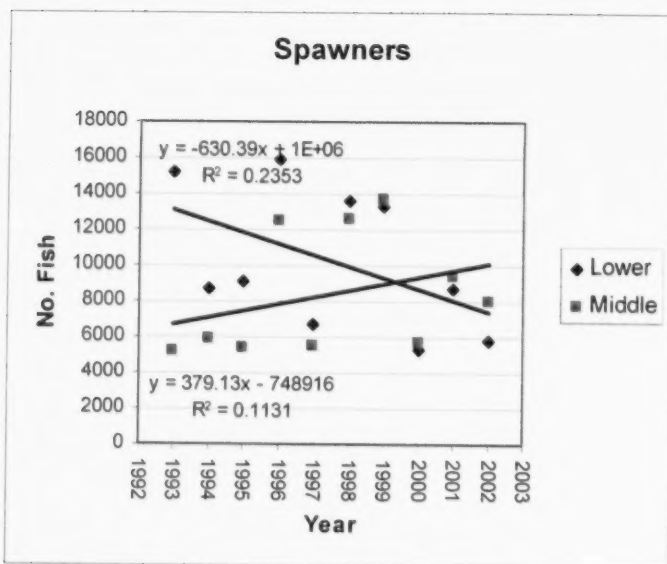


Figure 7: Plot of number of spawners by year (1993 to 2002) for the lower and middle Exploits with trend lines.